

1

3,005,624

MIXING APPARATUS

Peter Hoppe, Troisdorf, Karl Breer, Köln-Flittard, and Erwin Weinbrenner, Leverkusen, Germany, assignors, by mesne assignments, to Mobay Chemical Company, Pittsburgh, Pa., a corporation of Delaware

Filed Aug. 1, 1957, Ser. No. 675,605

Claims priority, application Germany May 11, 1956

2 Claims. (Cl. 259-8)

This invention relates generally to an apparatus for mixing liquids and, more particularly, to an improved apparatus for making polyurethane plastics. The present application is a continuation in part of our copending application Serial No. 657,618, now abandoned.

It has been disclosed that cellular plastics may be formed by mixing together a polyisocyanate and an organic compound having reactive hydrogen atoms. These compounds react chemically with each other to form a polyurethane compound. It is preferred to react a polyhydroxy compound with the polyisocyanate. Water is usually added in order to produce carbon dioxide which forms the pores in the resulting polyurethane product. Activators or catalysts are included in the formulation in order to control the reaction rate and the characteristics of the finished product.

It is necessary that the various components going into the polyurethane plastic be mixed together rapidly and poured into a suitable molding device before completion of the chemical reaction. An apparatus that is admirably suited for this purpose is disclosed in U.S. Patent 2,764,565, granted to P. Hoppe et al., September 25, 1956. This apparatus provides a means for intimately mixing the catalyst and other components of the polyurethane plastic together and permits accurate variation of the proportion of the components in the mixture as required to obtain the desired degree of rigidity or flexibility in the finished foam. It has been found, however, that relatively large slabs of the polyurethane plastic foam made with this apparatus may have a tendency to crack and the product may not always have a cellular structure that is relatively uniform in cell size. It has been proposed to include a paraffin oil or silicone oil in the formulation to avoid cracking of the hardened slab, but such additives remain in the finished foam thereby resulting in a product which may have undesirable chemical composition and undesirable mechanical properties. Moreover, such additives may foul the mixing equipment and troublesome and time-consuming cleaning operations may be required at frequent intervals.

It is therefore an object of this invention to provide an improved apparatus for mixing liquids together. A more specific object of the invention is to provide an improved apparatus for mixing the components of a polyurethane plastic together. Another object of the invention is to provide an apparatus for making polyurethane foam plastics having improved uniformity of pore size and improved physical characteristics. Still another object of the invention is to provide an apparatus and process for making polyurethane foam plastics of substantially uniform pore size and substantially free from voids. A still further object of the invention is to provide a method and apparatus for making large slabs of polyurethane foam plastic of substantially uniform pore or cell size having such physical characteristics that there is little or no tendency for the hardened foam product to crack. Another object of the invention is to provide a method and apparatus for making polyurethane foam plastics, without the addition of undesirable oils, that

2

have improved chemical and mechanical properties, resist cracking and have a substantially uniform cell structure.

Other objects will become apparent from the following description with reference to the accompanying drawing which illustrates an embodiment of the invention in a longitudinal sectional view.

The foregoing objects are accomplished in accordance with this invention by providing an apparatus having a mixing chamber in which the liquid components of a polyurethane foam plastic may be intimately mixed together, a discharge means and means for adjusting the size of the opening in said discharge means. The discharge means is preferably provided with a conduit or pouring spout through which the mixed components are poured into a suitable means for shaping the polyurethane reaction mixture as chemical reaction proceeds and the mixture changes from a liquid into a solid or non-fluid porous product. This mixing chamber is provided with a stirrer or agitator having a shaft and blades mounted thereon. The agitator shaft has one end which is of suitable size and shape to partially or completely close the discharge opening as the agitator or discharge means is moved with respect to the other. Preferably, the mixing chamber is provided with one end or bottom which can be moved with respect to the agitator to determine the depth of penetration of the opening by the shaft and thus determine the size of the discharge opening. The end of the agitator shaft is preferably substantially conical or frustoconically shaped and the discharge opening meshing therewith is of the same general shape. The shaped end of the agitator shaft may be provided with a scale which indicates the size of the opening at a given depth of penetration by the shaft.

In accordance with this invention, the mixture of components which react to form the polyurethane foam plastic may be prepared in the usual way, such as by the process disclosed in U.S. Patent 2,764,565, issued to Hoppe et al., or by any other suitable process. When using an apparatus of the type disclosed in the patent, the organic compound having the reactive hydrogen atoms, which is conveniently an hydroxyl polyester, an hydroxyl polythioether, an hydroxyl polyether or any other suitable compound, may be pumped or otherwise moved from a suitable storage vessel into the mixing zone or chamber where it is mixed with a polyisocyanate. A suitable catalyst or activator may be introduced simultaneously into the mixing zone under a pressure greater than the pressure in the mixing zone. In order to assure substantially complete mixing of the activator with the viscous polyester or similar compound, the activator may be injected into the mixing zone containing the polyester either continuously or intermittently. If intermittent injection is utilized, the frequency of the injection rate should be from about 50 to about 10,000 injections per minute with an injection rate of about 2,000 to about 10,000 injections per minute being preferred.

It has been found that it is possible to predetermine the cell or pore size of the finished polyurethane foam plastic by restricting the flow of reaction mixture through the discharge opening of the mixing apparatus. The invention is thus based on the discovery that the pore structure of the resulting polyurethane product depends upon the dynamic pressure of the mixture of components in the mixing chamber. It has been found that this pressure can be very accurately adapted to the proportions used for the components if the outlet end of the mixing chamber is constructed, according to the invention, as a nozzle cap movable longitudinally in relation to the stirrer, the end of the stirrer shaft forming